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CULTIVATION AND UTILIZATION OF BARLEY

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FARMERS' BULLETIN 968
UNITED STATES DEPARTMENT OF AGRICULTURE

Contribution from
the Bureau of
Plant Industry

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Washington, D.C.

June 1918

BARLEY should be more widely grown in the Northern and Western States. It is a protection to our grain supply, as it produces a good, nonglutinous flour and can be milled by wheat mills with little change of machinery.

It is an excellent grain feed for stock, being almost the equal of corn. It, however, competes with corn in few places, as it is mostly grown outside the limits of profitable corn culture. It produces more pounds to the acre than oats or wheat. If necessary, it can be seeded later than spring wheat, and hence interferes little with the wheat acreage in the spring-wheat region. It supplies the needed grain feed necessary for the increase of live stock, which sometime must come with diversified farming in the areas where grain farming is now the only enterprise.

The best lands for barley are well-drained soils that are not sandy. The best returns are obtained from early seeding. The best methods of preparation are fall plowing in the humid-spring region, disked corn ground in the Great Plains, and summer fallow in sections where the crop is winter seeded. The best method of seeding is with a drill, and the best method of harvesting is with a binder. The grain should not be thrashed too close, as broken kernels lower the market value.

The best-yielding varieties are Tennessee Winter in the humid-winter region, Manchuria and Oderbrucker in the humid-spring region, and Coast, Hannchen, Mariout, White Smyrna, Chevalier, and Trebi in the arid region.

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INCREASING THE ACREAGE OF BARLEY.

THE AREA on which barley may be profitably produced in the United States is more limited than that on which corn, wheat, or oats may be grown with profit. Barley is, however, exceptionally well suited to certain sections and in these sections is a very profitable crop. Its worth is not realized in some localities well suited to its culture. In the West its crop value is appreciated, but throughout the Northern States east of the Rocky Mountains the acreage under cultivation is far too small. In these States it is sound economics to increase the barley acreage for the purpose of producing feed for live stock. On account of the commercial use of barley for malting, its value as a feed is not well understood in these States, nor is the amount of food secured per acre realized by the average farmer. The acreage for stock feed could be greatly extended without prejudice to, and indeed to the advantage of, the maltsters, as there would be a larger offering from which they might choose.

This publication is intended to give a brief statement of the barley areas and the culture and uses of the crop in such a way as to enable the farmer to decide whether or not it is to his individual advantage to grow barley on his farm.

BARLEY REGIONS.

As shown in the accompanying map (fig. 1), the United States may be divided into three general climatic regions, which divisions differ in their economic, varietal, and cultural aspects, as well as their climatic features. These will be designated as the arid, the humid-spring, and the humid-winter regions. In the arid region the period from flowering to ripening is one of scanty rainfall and a very dry atmosphere. In the humid-spring region the same period is marked by frequent summer rains and a humid atmosphere. The humid-winter region is similar to the humid-spring, except that the barley is fall sown. In the arid region, the California crop is winter

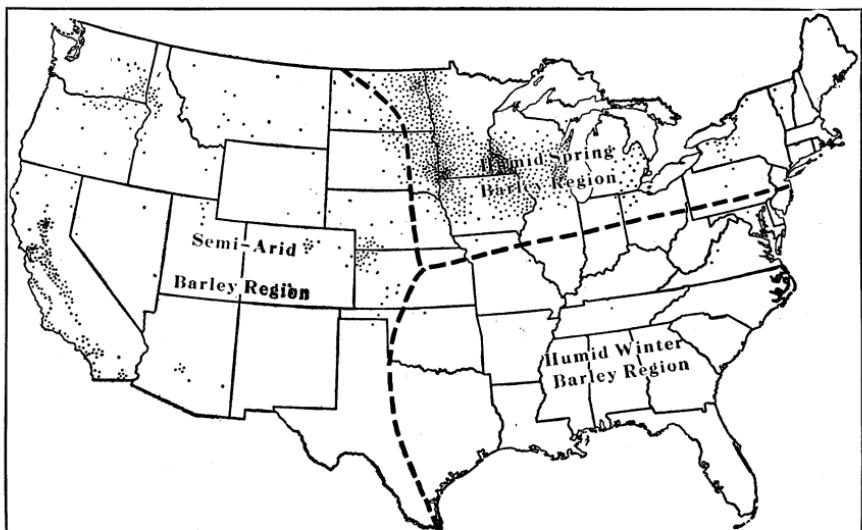


FIG. 1.—Outline map of the United States, showing the three general regions of barley production. The dots indicate the acreage of barley, according to the census of 1909. Each dot represents 5,000 acres. (Acreage map from Smith, Baker, and Hainsworth.)

sown, while in the States to the north and east of California it is spring sown.

It will be noted that the arid-humid line does not follow the line of rainfall in the North. This probably indicates a humidity-temperature factor. The southern Plains are much hotter than the northern, which would have a tendency to extend the humid belt in the North and contract it in the South. The line south of Nebraska is purely arbitrary, as barley is not a common crop in the southern Plains. The line separating the humid-spring from the humid-winter region is still more arbitrary. There is a wide belt between the northern limits of profitable winter-barley culture and the southern limits of profitable spring-barley culture in which barley is grown only in especially favored localities.

SPECIAL AREAS DUE TO CLIMATIC VARIATIONS.

The three general regions are subdivided into areas of special characteristics by variations in climate.

In the two humid regions there are few local variations. In the South, winter barley finds very favorable climatic conditions in the mountain areas, especially in eastern Kentucky and Tennessee. The total production, however, is insignificant. In the North some winter barley is produced in the neighborhood of the Great Lakes, especially in Michigan. This is of even less importance than the Kentucky-Tennessee concentration. In New York 2-rowed barleys can be grown with more comparative success than in the upper Mississippi Valley, but they yield less than the best 6-rowed variety.

In the arid region there are many variations, as might be expected from the topography. The Great Plains constitute a subdivision almost equal in rank with the three regions themselves. This area, while of light rainfall, differs from the rest of the arid region in having a summer rainfall which modifies both the conditions of growth and the varieties grown. The entire northern Plains constitute an area especially suited to the culture of 2-rowed barleys, while the extreme southern Plains are more suited to hooded sorts, as are certain localities of high altitude in the Rocky Mountain region. Several counties in northwestern Kansas have a climate unusually favorable to barley production, as is shown on the map (fig. 1).

The Great Basin has features peculiar to itself and distinct from California.

SPECIAL AREAS DUE TO SOIL VARIATIONS.

A study of the map (fig. 1) shows that even in the sections of greatest production, where every climatic feature is favorable, there are localities where very little barley is grown and others where it is almost a predominating crop. This distribution is due to differences in soil.

Barley is very sensitive to soil variation. It demands a well-drained soil, but does not thrive on sands. The projection of barley production into less favorable climates is noticeable in the barley soils which lie along the Mississippi, Missouri, and Arkansas Rivers. The effect of inadequate drainage is apparent in south-central Minnesota, an area favoring barley in climate, where, as shown in figure 1, a poorly drained area separates the heavy-producing sections on either side. Oats give a higher average return than barley in this section. As a rule, soil variations affect the acreage of barley grown, but have little relation to the varieties planted or the methods of production.

ECONOMICS OF BARLEY GROWING.

Barley is grown both as a cash crop and as a feed. West of a line from Bismarck, N. Dak., to Norton, Kans. (about the line of the one hundredth meridian) it is the principal grain feed. East of that line it is usually grown for market. In either case it must compete with oats, and in part of its area with corn. For the most part, barley is grown north and west of the limits of profitable corn culture. Corn, however, may be disregarded, as its cultural requirements limit its acreage to the farm labor available. Where it can be grown it gives higher feed returns than either oats or barley. On most farms, however, the farm management demands at least one spring-sown small grain. As a bread crop, wheat has had an entirely different market, and the cash returns have been in no wise interrelated until the recent demand for wheat substitutes. With the price per pound of barley flour equal to that of wheat flour, barley is much more profitable than wheat as a mill grain. In the absence of a milling demand, the only crop that can be compared readily with barley in farm economy is oats. Both are spring sown, and both are feed crops in that the excess of barley over the malting demands must depend on animal consumption for its market.

TABLE I.—*The average acreage and yields of barley and oats, with the calculation of protein, carbohydrates, and fat in 33 States for the years 1914, 1915, and 1916.*

States.	Acreage.		Yields per acre (pounds).									
			Protein.				Carbohydrates and fat ($\times 2.25$).		Total.			
	Barley.	Oats.	Barley.	Oats.	Barley.	Oats.	Barley.	Oats.	Barley.	Oats.	Barley.	Oats.
Maine.....	5,000	167,000	1,320	1,248	119	121	929	758	1,048	879		
Vermont.....	13,000	80,000	1,550	1,251	140	121	1,091	759	1,231	880		
New York.....	80,000	1,274,006	1,330	1,030	120	102	936	637	1,056	739		
Pennsylvania.....	9,000	1,114,000	1,320	1,056	119	102	929	641	1,048	743		
Maryland.....	5,000	45,000	1,584	966	143	94	115	586	1,258	680		
Virginia.....	12,000	222,000	1,320	678	119	66	929	412	1,048	877		
Ohio.....	33,000	1,683,000	1,340	1,059	121	103	943	643	1,064	746		
Indiana.....	12,000	1,654,000	1,278	1,050	115	102	900	637	1,015	739		
Illinois.....	56,000	4,371,000	1,526	1,200	137	116	1,074	728	1,211	845		
Michigan.....	92,000	1,489,000	1,280	1,130	115	110	901	686	1,016	796		
Wisconsin.....	608,000	2,100,000	1,483	1,178	133	114	1,044	715	1,176	829		
Minnesota.....	1,334,000	3,197,000	1,160	1,040	104	101	817	631	921	732		
Iowa.....	310,000	5,000,000	1,382	1,171	124	114	973	711	1,097	824		
Missouri.....	5,000	1,238,000	1,104	774	99	75	777	470	876	545		
North Dakota.....	2,422,000	1,070	954	96	93	753	579	850	672			
South Dakota.....	808,000	1,727,000	1,243	1,070	112	104	875	649	987	753		
Nebraska.....	109,000	2,208,000	1,320	1,060	119	103	929	643	1,048	746		
Kansas.....	270,000	1,603,000	1,142	890	103	86	804	540	907	626		
Kentucky.....	6,000	242,000	1,350	726	122	70	950	441	1,072	511		
Tennessee.....	8,000	356,000	1,195	730	108	71	841	443	949	514		
Texas.....	9,000	1,300,000	1,118	950	101	92	787	577	888	669		
Oklahoma.....	8,000	1,203,000	1,022	720	92	70	719	437	811	507		
Montana.....	82,000	597,000	1,478	1,331	133	129	1,041	808	1,174	937		
Wyoming.....	19,000	232,000	1,632	1,194	147	116	1,149	725	1,296	841		
Colorado.....	128,000	305,000	1,704	1,194	153	116	1,200	725	1,353	841		
New Mexico.....	8,000	59,000	1,650	1,098	149	107	1,162	666	1,310	773		
Arizona.....	34,000	9,000	1,728	1,242	156	120	2,117	754	1,372	874		
Utah.....	33,000	99,000	1,980	1,498	178	145	1,394	909	1,572	1,054		
Nevada.....	12,000	13,000	2,174	1,499	196	145	1,530	910	1,726	1,055		
Idaho.....	189,000	326,000	1,880	1,430	169	139	1,324	868	1,493	1,007		
Washington.....	174,000	282,000	1,949	1,587	175	144	1,372	963	1,547	1,117		
Oregon.....	131,000	363,000	1,670	1,354	150	131	1,176	822	1,326	953		
California.....	1,317,000	210,000	1,392	1,072	125	104	980	651	1,105	755		

In all the principal barley-growing States and parts of States barley is more profitable and produces more pounds to the acre than oats. Table I indicates that as a matter of farm economy the barley acreage in the northern tier of States should be expanded at the expense of oats. That it is not more widely grown now is due to two causes. Its value as a stock feed is not realized by the farmers east of Montana, and the brewing industry has dominated the market to such an extent that buyers of feed stuff do not think of barley as a feed crop. Barley must be considered as a feed in order to appreciate its true farm value. Not alone pounds, but pounds of digestible nutrients, should be considered.

In Table II the protein, fat, and carbohydrate contents are estimated from the analyses compiled by Henry and Morrison. In order to separate clearly the protein from the fat, the carbohydrates and fat ($\times 2.25$) have been united into a nonproteid factor, which has been used in Tables I and III. The total is the sum of the proteid and nonproteid constituents.

TABLE II.—*Digestible nutrients in each of the common cereals, as determined for animal feeds, according to Henry and Morrison.*

Kinds.	Digestible nutrients (per cent).				
	Crude protein.	Carbohydrates.	Fat.	Carbohydrates and fat ($\times 2.25$).	Total.
Barley.....	9.0	66.8	1.6	70.4	79.4
Oats.....	9.7	52.1	3.8	60.7	70.4
Corn.....	7.5	67.8	4.6	78.2	85.7
Wheat.....	9.2	67.5	1.5	70.9	80.1

The area in which barley often can be profitably substituted for oats is shown graphically on the map (fig. 2). This does not mean that there are no localities in this area in which it is not more profitable to grow oats or that there are no localities outside this area in which it is profitable to grow barley. It does mean that within the area the general climatic and soil conditions are more favorable to large yields of barley than of oats. In Table I the average yields of barley, as may be seen, are higher than of oats not only in the Northern and Western States, but the same is true for many other States as well. In many of these, however, the total production is so small as to be unfair to the oat acreage. Where the barley of a State is largely localized in a section of the State, small acreages have more meaning. A long-established local area is usually based on sound economy, but even here modifications are constantly arising. In the winter-barley section of Tennessee and Kentucky, for example, winter-barley production has been much more profitable than that of oats. The Hessian fly may alter this relation, as barley must be sown before the fly-free date.

Again, in California, barley is much more profitable than oats, when considered as a whole. Either on account of the hay or a local price, it has been estimated¹ that 161 acres of oats is equal to 167 acres of barley. As a matter of fact, barley and oats hardly enter into competition, as most of the oats are produced on the edge of the barley-growing districts. Wheat is the real competitor of barley in California, as it is more commonly grown on lands well suited to barley culture. Hunt estimates that 235 acres of wheat is equal to 167 acres of barley in income-producing capacity. The progressive de-

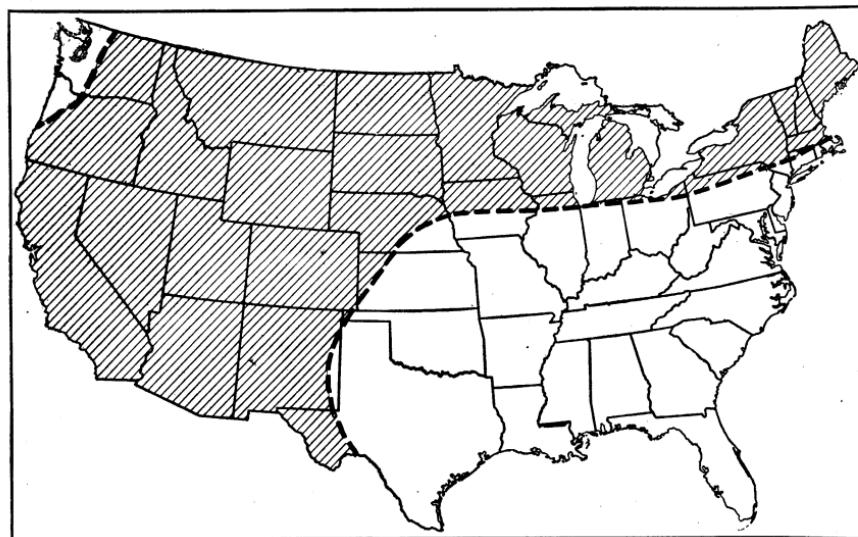


FIG. 2.—Outline map of the United States shaded to indicate the area in which the climate is relatively favorable for the production of barley. Within the shaded area, well-drained soils that are not sandy in character produce more pounds of barley to the acre than of either oats or wheat, while corn is a competing crop only along the southern margin. The actual line of separation is quite irregular. Barley culture extends south of the line on favorable soils, as in northwestern Ohio, while oats are more profitable north of the line on soils unfavorable to barley production, as in north-central Iowa and southwestern Minnesota. In the mountain and Piedmont regions of the South there are local areas well adapted to winter barley.

crease in the annual wheat acreage and the progressive increase in the barley acreage sustain these estimates.

The profits of barley are modified by the cultural reason for growing the crop. Often it is not a primary crop but a secondary one, grown because of its special fitness for some abnormal condition. In certain sections, as in northwestern Kansas, it is largely second choice to wheat. If the wheat seeding is successful, wheat is grown. If for some reason the ground can not be prepared for wheat, or if the wheat does not germinate through lack of rainfall, or if the wheat is winterkilled, spring barley is sown as a catch crop. On account of

¹ Some things the prospective settler should know. T. F. Hunt. *In Cal. Agr. Exp. Sta. Cir. 121.*

its rapid growth and early maturity, barley can be seeded later than other grains. This character is utilized in the spring-wheat area. On lands where spring wheat can not be seeded in time, barley is grown and is sure to give some sort of return.

Barley is often grown on new breaking, as its rank growth tends to subdue the wild grasses. It is commonly used to clean weedy fields, as a good growth of barley smothers many species completely. Its early maturity permits the crop to be cut before many other species have matured seed. Summer fallowing after the harvest destroys many more, and a single season of such treatment results in a marked decrease of the weed population.

Barley is also widely grown on old lands. After land has become too poor to produce good crops of wheat, it is seeded to barley. This sequence has been especially conspicuous in California. In Minnesota and Wisconsin the best barley is produced on old farm lands, which here happen to be of a fertile character. Older lands, where suitable in character and not too depleted, produce a better quality of barley than new lands.

From the standpoint of profit, these various cultural uses of barley must be considered. The returns from a catch crop or a weedy field can not be compared with those of a primary crop, yet a very considerable percentage of the barley acreage is grown on this basis. The figures in Table I would doubtless be more favorable to barley production if there were some way to compensate for these legitimate but hardly comparable acreages.

In general the results of the experiments conducted by the Office of Cereal Investigations are in agreement with the census figures shown in Table I. Table III shows the performance of the best varieties of barley and oats at various stations where cooperative experiments have been conducted. The results in this table have been previously published in various bulletins of the Department of Agriculture,¹ and it is recommended that these publications be consulted for more complete local information.

¹ Cereal experiments at Dickinson, N. Dak. J. A. Clark. U. S. Dept. of Agr. Bul. 33.

Cereal experiments at the Williston Substation. F. R. Babcock. U. S. Dept. of Agr. Bul. 270.

Experiments with wheat, oats, and barley in South Dakota. Manley Champlin. U. S. Dept. of Agr. Bul. 39.

Cereal investigations on the Belle Fourche Experiment Farm. Cecil Salmon. U. S. Dept. of Agr. Bul. 297.

Cereal experiments at the Akron Field Station, Akron, Colo. G. A. McMurdo. U. S. Dept. of Agr. Bul. 402.

Cereal experiments at the Judith Basin Substation, Moocasin, Mont. N. C. Donaldson. U. S. Dept. of Agr. Bul. 398.

Cereal experiments on the Cheyenne Experiment Farm, Archer, Wyo. J. W. Jones. U. S. Dept. of Agr. Bul. 430.

Experiments with spring cereals at the Eastern Oregon Dry-Farming Substation, Moro, Oreg. D. E. Stephens. U. S. Dept. of Agr. Bul. 498.

TABLE III.—*Comparison of the digestible nutrients per acre produced by the best yielding varieties of barley and oats.*

[Compiled from the published reports of experimental farms where tests have been conducted in cooperation with the Office of Cereal Investigations.]

Station.	Average for the years—	Best variety.		Yield per acre.		Digestible nutrients per acre (pounds).			Oats.				
				Bushels.	Pounds.	Protein.	Carbohydrates and fat.	Total.					
		Barley.	Oats.	Barley.	Oats.	Barley.	Oats.	Barley.					
Dickinson, N. Dak.	1907 to 1913	Hanna.....	Early Mountain.	34.9	54.1	1,675	1,731	151	168	1,179	1,051	1,330	1,219
Williston, N. Dak.	1909 to 1914	Manchuria...	Siberian.....	.....	2,088	2,256	188	219	1,470	1,369	1,658	1,588	
Highmore, S. Dak.	1906 to 1912	Hannchen...	Swedish Se- lect.	21.0	26.7	1,008	854	91	83	710	518	801	601
Brookings, S. Dak.	1906 to 1912	Odessa.....	Sixty Day..	32.4	43.5	1,555	1,392	140	135	1,095	845	1,235	980
Newell, S. Dak.	1908 to 1913	Hanna.....	.....do.....	10.7	19.4	514	620	46	60	362	376	408	436
Akron, Colo.	1908 to 1915	Hannchen...	Kherson.....	38.7	44.7	1,858	1,430	167	139	1,308	868	1,475	1,007
Moecasin, Mont.	1910 to 1915	White Smyr- na.	Sixty Day.....	.....	2,540	2,126	229	206	1,788	1,290	2,017	1,496	
Archers, Wyo.	1913 to 1915	.....do.....	Swedish Se- lect.	21.5	29.6	1,032	947	93	92	727	575	820	667
Moro, Oreg.	1911 to 1915	Mariout.....	Kherson.....	.....	1,646	1,402	148	136	1,159	851	1,307	987	

It will be noticed that only at Newell, S. Dak., are the pounds per acre of digestible nutrients produced by barley exceeded by the amount produced by oats. In Washington it was found¹ that in the years 1914, 1915, and 1916 the best variety of barley averaged 3,012 pounds of grain per acre, while the best variety of oats yielded but 2,756 pounds. The average for the State was still more in favor of barley. In experiments carried on by the Office of Cereal Investigations at Chico, Cal., barley yielded decidedly more than oats.

F FARMS AND SOILS WHERE BARLEY SHOULD BE GROWN.

Obviously, barley should be grown on those farms where it is more profitable as a cash or feed crop than the other small grains, if the growing of a small grain fits into the scheme of field management. As has already been pointed out, this means large areas in the Northern and Western States and small areas elsewhere. Its profitability or unprofitability depends entirely on how nearly its optimum requirements of growth are met. Barley is a cool-weather plant. The months of growth in the heavy-producing regions will be found to satisfy this requirement, and the greater part of the crop should be grown in these established areas. Within these areas favorable soils should be chosen.

Barley should not be grown on poorly drained land. Porous soils are preferred. With drainage or light rainfall, heavy soils produce

¹ Barley in Washington. E. G. Schafer and E. F. Gaines. Wash. Agr. Exp. Sta. Bul. 141.

good crops. Sandy soils, even though well drained, are not good barley soils. Clay loams are perhaps the best for barley. While barley produces well on rich, new lands, it can be grown more profitably than wheat on older lands, provided these lands are not too light and are well drained. Farms outside the average limit of profitable production, but still in a favorable climate, which possess desirable soil characters, may be cropped to barley with profit.

THE PLACE OF BARLEY IN THE ROTATION.

Over much of the barley-producing area no consideration is given to rotation of crops. Barley is still grown extensively rather than intensively in most of the Western States. Such rotation as is practiced is with the other small grains and ignores the greater objects of a rotation. Even in this area smaller farms are becoming common, and with the increase of live stock will come a diversification which will permit a cropping system which is now possible only in individual cases. East of the Red River Valley, barley is grown more as a crop of small farms and can enter into a cropping scheme.

In general, barley does best after a cultivated crop. This, in the United States, means corn. In Canada, excellent returns have been secured after root crops. In the United States, our root-crop acreage is limited to potatoes and sugar beets. The total acreage of these available for seeding to barley is too small to be considered. In the humid districts, where diversified farming is practiced, the most feasible rotation is one including corn and a leguminous hay or pasture crop.

Corn, followed by barley (seeded with grass), which in turn is followed by hay or pasture, is the essential combination of a rotation for this area. This is, of course, to be modified to suit local conditions and the nature of the farm. If intended for use as hay, the grass-seed mixture might be timothy and clover; if for pasture, the mixture might include a legume and nonleguminous grasses suited to the locality. If used for hay, the grass mixture would probably stand two years; if for pasture, it might remain a longer time. If grain feed is needed, two years of corn or two of barley might be used. In the case of two years of barley, the second year the barley might be sown at a lesser rate, so as to make a better nurse crop. Wheat may enter any of these rotations by adding one year to the cycle.

Where alfalfa is used, it is seldom profitable to break up the alfalfa land in less than three years, and it is usually profitable to leave it still longer.

In the arid regions corn is a far less common crop. The acreage is increasing, however, and the use of silos is certain to extend it still farther. Investigations have shown¹ that in the Great Plains the

¹ Barley in the Great Plains area: Relation of cultural methods to production. E. C. Chilcott, J. S. Cole, and W. W. Burr. U. S. Dept. Agr. Bul. 222.

largest returns per acre were secured after summer fallow; but on account of the cost of summer tillage, the crops on disked corn ground were much more profitable. Potatoes, where grown, occupy the same place as corn in the scheme of rotation. In eastern Oregon and Washington, and to a lesser extent in Idaho, Wyoming, and Montana, field peas may take the place of both the corn and the hay crop, the rotation probably being peas, wheat, and barley. Much of the barley west of the 98th meridian is certain to be grown without definite rotation until economic conditions have altered considerably. In the South, winter barley occupies the same place as wheat. The best returns are secured after plowing under a leguminous crop, as after cowpeas plowed under the first of September. In the Piedmont region corn in which crimson clover is seeded, crimson clover followed by cowpeas, and barley make a 3-year rotation which can be extended by the use of a second barley crop and, if in a stock-raising region, by the addition of pasture. In the Coastal Plains barley does not succeed well on sandy soils, and stock farming is not common. Where the soils are suitable, corn, cowpeas, and barley may form the basis of the rotation. In some places velvet beans are much better than cowpeas. The advisability of growing barley here usually would depend upon the relative cash returns of wheat and barley. In the South there is a possible exception. Where hogs are raised and fattened on peanuts, barley may be of unusual value in adding firmness to the fat.

MANURES AND FERTILIZERS.

Most of the barley of the United States is grown outside the regions where the use of commercial fertilizers is common. Even barnyard manures are little used in the arid regions. It is likely that the extensive use of both commercial fertilizers and barnyard manures will be confined to the two humid regions for some time to come.

BARNYARD MANURE.

Barnyard manure, when well rotted, is the best farm fertilizer. It not only supplies plant food, but stimulates many desirable forms of bacteria found in the soil. It gives the soil a better texture and a higher moisture-holding capacity. In the humid-spring region it is best applied to the crop preceding barley, preferably corn. In this region the quality of barley often suffers from too much nitrogen, and the straw lodges easily. The addition of a nitrogenous manure causes a ranker growth, which usually results in lodging and difficult harvesting. In the South, where the soil is not so rich, manure plowed under in time to be well decomposed by seeding time is very beneficial.

COMMERCIAL FERTILIZERS.

The use of commercial fertilizers for barley is limited to the eastern part of the United States. It is probable that profits could be secured from their application in sections where it is not a common practice. It is improbable, however, that this is the most desirable way of investing such cash surplus as may be available west of the Mississippi River. The greatest need is, of course, in the South. Lime is the cheapest and most easily procured of the commercial fertilizers. It is not a simple fertilizer, as in the case of nitrogen, for instance, since it is applied to correct acidity and only incidentally to supply calcium. Many of the soils of the humid-winter regions are acid. The use of lime is common throughout the South. Lime can be more evenly distributed with a drill than by hand. In the Eastern and Southern States 1,500 pounds of burnt lime or 3,000 pounds of crushed limestone to the acre can be applied to advantage where lime is needed. The frequency of application depends both on the character of the soil and the nature of the crops grown. Some soils require an application only once in several years, and it is seldom that lime is required more frequently than once in three years. The application should be so timed in the rotation that clover and similar crops are grown upon recently limed soil, while rye and other acid-enduring crops are grown when the supply of lime is lowest.

Applications of lime are doubly important when barley is used as a nurse crop for red clover, which can not be grown on an acid soil.

The three elements usually supplied by the so-called complete fertilizers are nitrogen, phosphorus, and potassium. Nitrogen is commonly secured in nitrate of soda and ammonium sulphate or from such organic materials as tankage and cottonseed meal. Phosphorus is usually obtained in acid phosphate or the raw rock phosphate from which the acid phosphate is manufactured. Basic slag and bone meal, which contain phosphorus, are also widely used. The phosphorus in the acid phosphate is much more available than in the raw rock. The acid form is to be preferred. Raw rock is best used in heavy applications in connection with green manure or in mixing it with stable manures some time before applying it to the field, or sometimes by a daily addition to the stable accumulations. If raw rock is used in a complete fertilizer, the nitrogen can best be added in ammonium sulphate. Potassium can be secured as kainit and sulphate or muriate of potash.

In grain farming complete fertilizers are also used. The formula varies so with the nature and condition of the soil that exact proportions can not be given. Even the basis of the amount removed by the various crops is not particularly significant, because one or more of the three elements in question may be present in abundance.

In general, for grain farming in the Eastern and Southern States a fertilizer approaching a 3-10-3 formula will be satisfactory; that is, a complete fertilizer with nitrogen, phosphorus, and potassium present in the proportions given.

The aim of every farmer, however, should be to avoid the use of a complete fertilizer. Fertilizers are expensive, and a proper handling of the farm enterprises may cut down their use materially. No farmer should find it necessary to purchase nitrogen. Nitrogen can be secured free from the air by the use of clover, alfalfa, cowpeas, soy beans, velvet beans, or vetch. Any scheme of crop management should embrace one or more of these crops. The rotation mentioned earlier provided for supplying nitrogen by this means.

Potash is usually present in sufficient quantity, though not always available. Green manures and barnyard manures tend to make potash available. The same scheme that adds the nitrogen will ordinarily free sufficient potash for the needs of the crop. Phosphorus alone is the element that may need to be supplied direct to farms of the East and South. The more live stock enters into the management of the farm, the less phosphorus will need to be added. The scheme of adding phosphate to the stable manure is ideal, but seldom sufficient. Only the most specialized of live-stock farms produce enough manure to cover their entire area in any reasonable number of years. Green manures and legumes must supplement these applications; and to them, in certain areas, phosphates must be added to maintain a high productivity.

GOOD SEED.

Good seed is an insurance that the crop makes its initial growth without handicap. It means a good deal more than merely seed that will grow. It means seed that will grow vigorously and mature a desirable sort of grain that is free from disease.

To secure such seed it must be, first, a desirable variety. The varieties are discussed later. It must be from a field that was properly cared for the previous year. The grain should have been well matured and so shocked and stacked that it escaped weather and heat damage. Grain that has passed through the sweat in the stack germinates more vigorously and in higher percentage than that thrashed and placed in the bin immediately after cutting. Weather damage in the shock seriously injures the vitality of the seed.

The grain should be free from weed seeds and diseases. Noxious weeds are often introduced on the farm through the seed. It is much cheaper to pay a few cents a bushel more for certified seed than to use seed of doubtful character. It is better to get seed from clean fields than to treat it for diseases. Where diseases are present in quantity they should be treated or disease-free seed obtained.

Seed that is otherwise desirable often has a percentage of poorly developed kernels. These can be removed with a fanning mill. While good plants can sometimes be secured from small seed, they are likely to be weak and are usually crowded out. It is best to remove the lighter grain and use it as feed. The fanning mill, while performing this function, will at the same time remove many kinds of weed seeds.

PREPARATION OF THE SOIL.

The ideal seed bed is one in which the bottom is firm but not too hard for the easy penetration of water and the growth of roots, while the upper 2 inches are loose. The soil should be so firm that



FIG. 3.—Drilling grain on a well-prepared seed bed.

few grains will fall in spaces too large to secure the contact with moist surfaces necessary for germination and thus result in an uneven start. The right kind of a seed bed is shown in figure 3.

The aim of the operations in seed-bed preparation is to approximate the ideal seed bed at the least possible cost. Very comprehensive data on seed-bed preparation in the Great Plains area have been published by the United States Department of Agriculture.¹ While not directly applicable to other barley-growing districts, the figures are so suggestive that one of the tables is copied entire in Table IV of this bulletin.

Both production and profits are shown. These, of course, vary from day to day. The price used as the basis of cost computation in Table IV is 41 cents per bushel in the shock. At that price disked

¹ Barley in the Great Plains Area. E. C. Chileott, J. S. Cole, and W. W. Burr. U. S. Dept. Agr. Bul. 222.

corn ground was found to be the most profitable on the Great Plains. In the humid-spring areas disked corn ground or fall plowing is probably the cheapest. From the point of returns, fall plowing is best in this region. In the Dakotas preference is frequently given to wheat, and the barley crop is placed on late spring plowing, which is harrowed and planted at once. Necessity justifies this practice, as it is often the only possible way to put in a crop. When this is done, all the labor which can be given without sacrifice of acreage should be devoted to the reduction of the soil to a firm condition.

TABLE IV.—*Comparison of the average yields and profit or loss in the production of barley by different methods of tillage at 14 stations in the Great Plains area.*

[Data according to Chilcott, Cole, and Burr. The profits and losses were based on prewar prices for equipment and labor, and a farm price of 47 cents per bushel for barley.]

Statement.	Number of years averaged.	Methods of tillage.					
		Fall plowed.	Spring plowed.	Listed.	Sub-soiled.	Disked.	Green manured.
Yields per acre (bushels):							
Judith Basin, Mont.	5	24.0	24.0	29.0	30.5	29.0	30.2
Huntley, Mont.	2	29.6				34.5	43.8
Williston, N. Dak.	5	17.4	16.1			27.5	28.8
Dickinson, N. Dak.	6	25.1	24.6			37.4	32.5
Edgeley, N. Dak.	8	16.7	18.5			23.4	20.0
Hettinger, N. Dak.	3	19.9	25.5			14.9	31.8
Belle Fourche, S. Dak.	6	7.6	8.3	7.7	8.0	12.2	12.6
Scottsbluff, Nebr.	2	14.0	15.4	14.4	15.0	18.6	27.6
North Platte, Nebr.	8	17.1	15.9			13.4	26.7
Akron, Colo.	6	18.6	18.8	17.9	14.0	18.4	24.8
Hays, Kans.	6	13.6	11.2	12.7	14.6	14.1	19.3
Garden City, Kans.	5	6.9	4.3	8.3	6.9	8.9	11.0
Dalhart, Tex.	4	3.9	1.9	4.4		1.6	6.4
Amarillo, Tex.	6	8.2	5.7	6.1	6.8	6.6	12.6
Profit or loss (—) per acre:							
Judith Basin, Mont.	5	\$3.38	\$3.85	\$6.44	\$5.44	\$7.24	\$0.98
Huntley, Mont.	3	6.15				9.50	\$3.45
Williston, N. Dak.	5	.67	.61			6.63	.41
Dickinson, N. Dak.	6	3.83	4.10			10.68	1.93
Edgeley, N. Dak.	8	.39	1.60			4.94	-3.20
Hettinger, N. Dak.	3	1.70	4.47			1.46	1.64
Belle Fourche, S. Dak.	6	-3.34	-2.59	-2.29	-3.79	.35	-6.23
Scottsbluff, Nebr.	2	-.72	.32	.45	-.92	2.98	-.08
North Platte, Nebr.	8	.55	.53			.84	-.55
Akron, Colo.	6	1.17	1.72	1.89	-1.33	2.89	-1.23
Hays, Kans.	6	-.88	-1.40	-.24	-1.08	1.13	-3.49
Garden City, Kans.	5	-3.63	-4.23	-2.05	-4.24	-1.00	-6.89
Dalhart, Tex.	4	-4.86	-5.21	-3.65		-3.99	-8.78
Amarillo, Tex.	6	-3.10	-3.65	-2.95	-4.28	-1.94	-6.23

In California plowing is usually delayed until the fall rains begin. Much of the sowing is on land that is plowed in January or February and even in March. The seed bed is frequently far from ideal. After summer fallow the seed bed is good and needs no modification. In fall plowing, advantage should be taken of all the early rains and a seed bed prepared as early as possible. The disk can be used after the first rain and the ground made more receptive and the plowing easier. The custom of volunteer crops should be discontinued. Disked land should be used only when there is not time for plowing, as early seeding is an important consideration in California except on subirrigated lands.

In the South, winter barley is seeded after a variety of crops. Although good results are sometimes secured after corn, that crop is too late in maturing to prepare the soil for the best time of seeding. For this reason it is not advised. If seeded after corn, a disk is the best implement for preparing the seed bed.

When barley follows a small-grain crop the land is frequently plowed immediately after harvest and allowed to lie fallow until fall. Cowpeas can be grown to advantage after a winter grain and turned under as green manure. In this case the ground should be plowed some time before seeding, to allow it to settle as much as possible. If the pea crop is removed for hay, disking is preferred to plowing.

DATE OF SEEDING.

The maximum returns from barley are obtained when the crop is seeded early. The fact that spring barley can be seeded quite late and still mature a partial crop has led to considerable abuse of the latitude that its early maturity makes possible. It is the common practice to seed barley after the seeding of oats and spring wheat has been completed. From the farm standpoint this practice is justified by the requirement that the oats and wheat must be sown early. From the standpoint of barley culture it is not good practice and results in reduced yields. As a matter of fact, spring barley should be sown at about the date generally observed for sowing spring wheat, if the best results are to be obtained. In certain localities where the spring opens late this is not always possible, but the losses arising from late seeding should be realized and all efforts made to hasten the spring work. Large grain farms, such as are found in North Dakota, present the most difficult problems. The work on all crops falls in a very short period, and if weather conditions are adverse it is not physically possible to complete the seeding during the period when the best results are to be obtained. It has been shown¹ that the period of barley seeding in North Dakota extends over 25 days, while in Wisconsin the seeding is accomplished in 16 days. This means that in Wisconsin barley is a primary crop, grown on farms so small and so diversified that the farmer grows it for the sake of the barley crop and is able to seed it near the proper time for seeding barley. In North Dakota, on the contrary, barley is seeded when the wheat and oats seeding permit. In Wisconsin the greater part of the crop is seeded during the most favorable period. In North Dakota most of it is seeded later than this period.

Of course, there is variation from season to season, but, in general, barley should be seeded as early as the ground can be well worked in the spring. If the soil is of a heavy, cold character, it should be

¹ Seedtime and harvest. J. R. Covert. U. S. Dept. Agr., Bur. of Stat. Bul. 85.

seeded a little later than the lighter soils, as the soil must have some warmth at seeding time. The recommendation of early seeding should not be followed to such an extreme as to plant the grain in a backward spring in soil that must be worked wet to prepare it for such early date. Neither should the ground be allowed to remain weedy in order to hasten the date. On the other hand, no time should be lost when the ground can be worked with safety, especially if it has acquired some warmth. In the northern Plains, the most favorable period is from April 1 to April 25. Figure 4 indicates the yields according to time of seeding in Montana, North Dakota, and South

Dakota, from data made up from the experiments at a number of stations. In only one instance at one station did the earliest date produce less than the maximum yield. After April 20 the yields began to be somewhat less, and in no case did seeding as late as the first of May produce a maximum yield. The loss after April 25 is more than 1 per cent a day. These tests were all in well-prepared seed beds, and it is possible that the earliest seedlings on soil that is less well

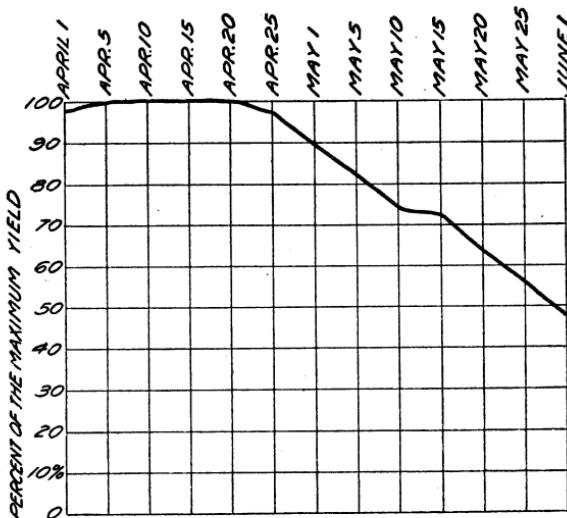


FIG. 4.—Diagram showing the percentage of the maximum yield that has been obtained on various dates of seeding at field stations in North Dakota, South Dakota, and Montana. Seeding later than April 25 has resulted in a loss of more than 1 per cent for each day that seeding was delayed. Seeding the last of May has given only about 50 per cent of the maximum yield. In southeastern Minnesota and Wisconsin, the best date to seed is correspondingly earlier.

prepared might not produce results as favorable as those here shown. It is certain that the falling off in yield would show as quickly on any seed bed, owing to less favorable climatic conditions during the ripening period.

The loss of at least 1 per cent a day after April 25 must be reckoned as a probable average for a series of years. This means that on a field of 50 acres of barley which if seeded in time would yield 30 bushels per acre, there is a loss for the field of at least 15 bushels a day for every day that seeding is delayed beyond April 25. This is the average date for these States. In Montana and the extreme northwestern portion of North Dakota the date is three or four days later, and in some parts of South Dakota it is three or four days

earlier. The variation is not as much as would be expected. The seasons in southern Minnesota, Iowa, and Wisconsin are slightly earlier, and the consequences of late seeding are more disastrous than in the case of the other States mentioned. Seeding as late as the first of May in southern Minnesota and Wisconsin is to be discouraged. In New York and New England the cool summer permits a slightly later seeding. In Oregon and Washington, spring-sown barley should be put in as early as possible. In California, data collected by G. W. Hendry show that early seeding (before Dec. 20) produces the maximum yields, while late seeding (after Jan. 25) shows a yield more than 20 per cent less than the earlier date.

In the Southeastern States winter barley must be seeded early. September seeding has given good results at most places in the barley-producing area. In the southern edge of the humid-winter belt, October seeding is frequent.

RATE OF SEEDING.

The best rate of seeding barley varies widely with the season, and maximum yields are obtained at rates covering a wide range. A single plant accommodates itself to its individual conditions. If it is crowded by other plants, it produces only one or two culms, but in an open space it may produce several. The best rates are usually heavy enough to insure that the thinnest spots on the field will have enough plants for a maximum yield. In the humid regions this maximum under favorable conditions might be obtained with a seeding of 5 pecks per acre, yet at the same time 10 pecks per acre would not decrease the yield. As the seed bed is not usually perfect and as adverse weather conditions subsequent to seeding may decrease the stand, 2 bushels per acre are usually seeded in the humid sections. In the northern Plains 4 pecks per acre have given about the same returns as 8 pecks. Four to 6 pecks are usually recommended. Six pecks are too much in the driest years and in localities where the average season is known to be severe. Four pecks are recommended for such places. In other parts of the northern Plains, especially along the eastern limit, 6 pecks may often be sown to advantage, though it is usually more than is necessary if the seed bed is in prime condition. In the very driest localities of the Dakotas and Montana and in the Great Basin, 3 pecks are sometimes seeded to advantage. In California, 7 pecks per acre are usually seeded. In the winter-barley district of the Southeastern States 8 pecks are recommended. Where a naked variety is grown, not more than three-fourths of the rate for hulled barley should be sown. Where barley is grown as a nurse crop, about 25 per cent less grain should be seeded than for a grain crop, as a thin stand allows a better growth of forage plants, a good stand of which is shown in figure 5. When grown for pasture, the rate should be increased 25 to 50 per cent.

DEPTH OF SEEDING.

The seed of barley should be placed in the ground at such a depth that it can secure both moisture and air. In the humid regions, if planted too deeply, excessive moisture may shut off the air supply and reduce the temperature to the extent of decreasing the germination. In the arid region, too shallow planting may result in poor germination through lack of moisture. In the humid regions, the best conditions are found at a depth of about $1\frac{1}{2}$ inches. In the northern Plains this should be increased to 2 inches. In the Great

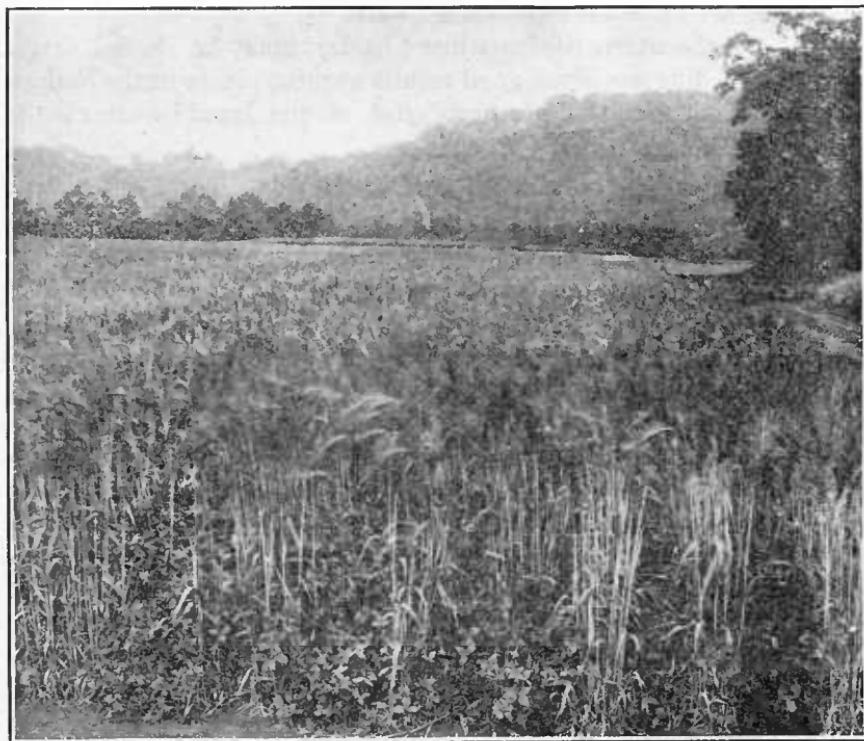


FIG. 5.—A field showing winter barley as a nurse crop for red clover.

Basin the best depth is from $2\frac{1}{2}$ to 3 inches. At Nephi, Utah, 3 inches was found to give the best results for the depths tried, but no seeding was made at $2\frac{1}{2}$ inches.

METHOD OF SEEDING.

Drilling with a grain drill is the best method of seeding barley. The drill is constructed for the purpose of placing every seed in the most favorable location. For this reason it is much more economical of seed than broadcasting. Under favorable conditions of soil and moisture, broadcasting may produce yields as high as those obtained

from drilled seed. As the conditions become adverse, the results are more and more in favor of drilling. In the drier regions the grain must be placed at some depth beneath the surface to secure an even germination. This can not be done uniformly by any means except the drill. Any good grain drill will do the work successfully on a well-prepared seed bed. If the ground is covered with trash, as disked corn ground, the single disk drill is to be preferred.

Broadcasting should not be practiced where it can be avoided. It is particularly undesirable to broadcast seed on dry ground, as part of it may be harrowed in deep enough to secure germination, while the rest may lie for days awaiting a rain to start growth. This results in a very uneven stand. In moist soil, under favorable conditions broadcasting is not so objectionable. In the interior valleys of California where the plowing, seeding, and harrowing must be done quickly, before the rains begin, broadcasting is often employed to save time. Even here, although conditions are unusually favorable to broadcasting, better results are obtained with a drill, and where the ground is in suitable condition and sufficient equipment is available to seed the acreage without delay, a drill should be used.

TIME OF HARVESTING.

The time of harvesting barley depends on the use of the crop, the variety, the climate, and the method used.

For seed, brewing, or feed, the crop should be mature. The maturity should not be judged by the earliest spikes. If possible, the latest spikes should be mature, as this will insure that no part of the crop will be shrunken from having been harvested too soon. If the stand is thin or uneven, this may not be possible, as the earlier spikes of many varieties would begin to shatter. By maturity is meant the point where material ceases to be added to the kernel and not that the grain has become dry. There are several popular tests which indicate this period. The kernel at this time can be dented with the thumb-nail and retains the dent for some time. The milky juice largely disappears from the furrow. The hull begins to wrinkle on the ripest grain, showing the shrinkage of the kernel beneath. After this point is reached, ripening is merely the loss of moisture and can take place in the shock as well as if left uncut.

Nurse crops of barley are often cut somewhat earlier than grain crops, but this is for the purpose of favoring the development of the grass seeded with the barley and does not enter largely into the general problem of barley harvest.

As a hay crop barley is harvested still earlier. It is not, however, cut while in bloom, as is customary with many of the grasses. The grain is allowed to develop almost to its maximum. The grain content of barley hay constitutes a considerable part of its feed value.

Barley is highly prized as a hay crop in the West, despite the coarse awns which frequently cause sore mouths in horses and cattle. Sometimes the hooded varieties are grown for hay, in order to eliminate this objectionable factor. Much of the hay, however, is incidental; that is, the barley is sown for grain. If the season is favorable, it is harvested for grain; if unfavorable, it is harvested for hay.

The time to harvest sometimes depends on the variety. Some varieties shatter badly when ripe, while others do not. Hooded and awnless sorts shatter most easily. The Coast type (Bay Brewing, California Feed, etc.) shatters much less than the other types. The types which shatter must be harvested promptly. The best of the Coast type can be left until the full maturity of the latest culms and suffer but moderate losses for some time after complete dryness.

The climatic conditions at the time of harvesting have some influence on the stage at which barley is cut. In a section subject to storms the harvest must be accomplished within a very few days. If the straw is too green it will not dry out properly in a humid climate and there may be mold damage. If harvest is delayed too long much grain might be lost through the occurrence of a storm, as all barleys in humid climates shatter rather easily. In the arid region, green barley dries out readily and storms are not so common as to cause shattering in the overmature crop. The varieties in the arid regions outside the Great Plains do not shatter readily.

METHODS OF HARVESTING.

There are but three common methods of harvesting barley, by the use of the binder, the header, and the combined harvester. The grain binder is the implement of the intensive farmer and is by all means the best where it can be used. The grain can be cut with less loss. It can be cut at the optimum time and in the humid regions can be stored with less damage than by the other methods. When cut with the header or the combined harvester, the grain is allowed to ripen more completely than when cut with the grain binder.

The header is important in the Plains, where it is a rapid means of harvesting large acreages. It is very useful in harvesting crops where the straw is too short for the best use of the binder. Some varieties, such as the White Smyrna, are very difficult to harvest with a binder, on account of their short straw. The common use of the combined harvester is confined to the Great Basin and California.

When the combined harvester is used the grain must be ripened to dryness. In California the crop often stands three weeks after maturity before being cut. Only varieties of the Coast and Mariout types are suitable for this practice. None of the other common varieties will stand after they are ripe without losing a large part, probably the greater part, of the grain. In California, in a total yield of 31.1

sacks per acre, there was a loss of 6.6 sacks per acre when the combined harvester was used, while only 1 sack per acre was lost when the grain binder was used.¹ This loss of 1 sack included the loss at the thrasher. The loss of the crop by the use of the combined harvester was 21 per cent, while that of the binder was 3 per cent. Prof. Hendry states that although it might be held that the shattering loss was unusually high in this case because the yield was above the average, observations made in various parts of the State would indicate that the contrary is true and that the percentage of shattering is usually higher in the case of the lower yields. He also states that, while the cost of production is lower with a combined harvester, the net proceeds are in favor of the use of the grain binder.

The grain lost by shattering is sometimes allowed to volunteer for the next crop. This practice is not to be recommended, as it is unprofitable.

SHOCKING, STACKING, AND THRASHING.

Grain is usually shocked after being cut by the binder. The object of shocking is to protect the grain as far as possible until it is thrashed. The treatment of course varies with the climate of the section. The more humid the section, the more trouble is experienced in safely harvesting the crop. Weather is the main source of shock damage. The shocks should be built with this in mind. If the straw is not quite dry, oblong shocks without caps are best. If the section is one where windy weather prevails, the grain may be left in this form of shock until stacked or thrashed. In the rainy districts, winds permitting, these oblong shocks should be changed to the round type and capped when dry. Ordinarily, of course, the grain is dry enough to put in a round shock and be capped at once. After heavy rains, if the shocks have become wet inside, they must be opened and the bundles spread out to dry. The bundles should be laid across one another in such a way as to keep the heads off the ground.

The grain should stay in the shock as short a time as possible. Rain is certain to discolor and injure the cap sheaves. If the bundles become wet enough to require spreading, most of the grain will be discolored at least. There are various species of fungi that aid in the discoloration, and if the grain remains moist any length of time odors of mold will persist after thrashing. Discoloration and mold odors greatly lessen the price when the grain goes on the market as malting barley. Weather damage, aside from the direct loss of germinated grains, affects the viability of the seed and its value for seed and malting purposes. For these reasons the grain should be either stacked or thrashed as soon as possible after it is cut. Stack-

¹ Harvesting grain in California. G. W. Hendry. *In Jour. Agr.*, Univ. Cal., v. 3, no. 4.

ing gives the finest quality of grain for seed or malting. The grain goes through the sweat in the stack, which seems to increase the percentage and vigor of germination. Sweating also occurs in bin grain thrashed from the shock soon after cutting. Bin sweating is not as normal as that in the stack and there is some danger of heating. There is some loss of weight in sweating, and properly cured barley should bring a higher price than grain direct from the field. It costs about 1 cent per bushel more to stack grain than to thrash from the shock. When grain is stacked the work should be carefully done and the stacks made in such a way that they shed water perfectly. Poor stacking may result in large losses. Unless skilled labor is available, it is better to stack under sheds or other shelters, if it is possible to do so.

Barley must be thrashed carefully. About one-fourth of the crop is used for malting. Its value for this purpose can be greatly affected by improper thrashing. In the process of malting, barley is germinated at temperatures and in a humidity favorable for fungous growth. The grains are protected by a heavy layer of cells that surround the starchy interior. If this layer is injured the fungi gain entrance and feed upon the material stored in the grain. Injury in thrashing comes about in two ways: Many kernels are actually broken in half, and many others are thrashed too close. Close thrashing breaks off the tips and exposes the body of the grain to attacks of fungi. The concaves should be so set as to avoid these injuries.

COST OF PRODUCING BARLEY.

The cost of producing barley varies with the section of the country, the cost of man and horse labor, the price of seed, and the amount of capitalization. These items themselves vary from year to year in any section. At present the cost is considerably higher than it was even three years ago.

In Table V is given a compilation of the data published by several investigators.¹ Their work represents the three general areas which present marked differences of economic conditions and cultural practices. The farms of the humid-spring region, where land values are high and the agriculture more or less diversified, are represented in the Minnesota averages. In the Great Plains land values are low, with grain farming the main enterprise. In California land values are about the same as in Minnesota. The barley is raised on farms devoted almost exclusively to grains and is usually harvested with the combined harvester.

¹ Barley in the Great Plains area. E. C. Chilcott, J. S. Cole, and W. W. Burr. U. S. Dept. Agr. Bul. 222, p. 13.

The cost of producing Minnesota farm products. F. W. Peck. Minn. Agr. Exp. Sta. Bul. 145. Harvesting grain in California. G. W. Hendry. In Jour. Agr., Univ. Cal., v. 3, no. 4.

TABLE V.—*Prewar cost of producing an acre of barley in three representative sections of the United States.*

Locality and method of preparation.	Method of harvesting.	Preparation of land.	Seed.		Seeding.		Cutting and shock-ing.	Interest, taxes, depreciation, and general expenses. ¹	Total cost of grain in shock.	Stacking and thrash-ing.	Total cost, thrashed grain.
			Seed.	Seeding.	Cutting and shock-ing.						
Minnesota: ²											
Fall plowed . . .	Binder	\$2.08	\$1.58	\$0.31	\$0.81	\$5.37	\$10.15	\$1.93	\$12.08		
Great Plains area: ³											
Disked corn land.	.....	.97	.75	.40	.93	1.60	4.65	.....	.....
Listed . . . . .	.....	1.77	.75	.40	.93	1.60	5.45	.....	.....
Spring plowed . . .	.....	2.31	.75	.40	.93	1.60	5.99	.....	.....
Fall plowed . . .	.....	2.78	.75	.40	.93	1.60	6.46	.....	.....
Subsoiled . . . . .	.....	3.39	.75	.40	.93	1.60	7.07	.....	.....
Summer tilled . . .	.....	6.12	.75	.40	.93	3.20	11.40	.....	.....
California: ⁴											
Fallow	Binder	1.75	1.00	.40	1.55	11.17	15.87	4.30	20.17		
Do	Combined harvester	1.75	1.00	.40	.....	11.17	.....	.....	17.72		

¹ The sums given in the column of interest, etc., in the case of the Great Plains region include only interest and taxes and not depreciation and general expenses.

² Average of farms in three localities during the years 1908-1912, according to Peck.

³ Average of eight stations in the Great Plains area, during the years 1909-1914, as given by Chilcott, Cole, and Burr.

⁴ Cost based on a 31-sack crop in 1915, according to Hendry.

In Table V some liberties have been taken with the figures of the various investigators. Hendry's figures, for example, were originally a comparison of the two methods of harvesting. He carries the cost to the place where the barley is in the warehouse. In the cost of thrashed grain he includes sacks. These are omitted here because the figures would not then be comparable with those of the other investigators. As far as California is concerned, they should be included. Hendry's total cost in the warehouse was \$22.79 for the combined harvester and \$26.13 for the grain binder. Much of the extra cost of the binder comes from the extra quantity of grain handled, $5\frac{1}{2}$ sacks more being secured by the use of the binder than by the use of the combined harvester. The net profit per acre is greater with the grain binder.

In the cost per acre of grain in the shock the variations are of interest. The grain in the shock is the fairest point of comparison, as Chilcott, Cole, and Burr do not carry their figures farther. The overhead charges of Peck are just about one-half those of Hendry. In Minnesota a crop is raised every year, while in California a crop of 31 sacks could not be expected except when the land was fallowed every alternate year. The overhead charge of Chilcott, Cole, and Burr in the Great Plains is low, owing to low land values and to the inclusion of part of the depreciation in the labor cost. The overhead charge is the largest single item and the one commonly ignored by farmers who own their own land and equipment. Farmers usually figure their profit without considering either the interest on their

investment or their own labor. In most of the barley-growing districts a satisfactory margin exists between the cost of production and the cash returns. From the current price of barley the number of bushels necessary to meet the cost of production is readily computed. It is the grain in excess of this quantity that constitutes the profit of the farmer. As the cost of farm labor and materials has advanced greatly during the war the farmer must add this extra cost in making estimates at present.

USES OF BARLEY IN MANUFACTORIES.

The market price of barley depends in part on its suitability for the use to which it is to be put. The factory markets are for malting, pearl barley, breakfast-food preparation, and flour. The maltsters require a clean, well-matured, undamaged grain of high viability. Damage may result from either harvest, shock, bin, or thrashing injury. Barley that is cut too soon—that is, before the grain is really mature—is usually classified as harvest-damaged grain. Shock damage arises from adverse weather conditions. This has been previously discussed and need not be repeated. Bin damage comes from the storage of moist barley or from leaks after storing. On the farm about the only remedy for bin heating is shoveling the grain to another bin when it heats. If floor space is available, spreading it out over a large area and shoveling it over every day or two will save very moist grain from injury. In elevators it is comparatively easy to aerate grain by running it into another bin. Musty barley makes musty malt and musty malt carries objectionable flavors into the malt liquors when used for that purpose. Thrashing injuries promote the growth of molds in the germinating chambers. Carefully thrashed grain is of more value to the maltster than poorly thrashed grain.

Barley that is raised for malting should be of the variety or at least the type common to the region, unless previous arrangements have been made with the buyer and there are facilities for keeping it separate. A mixture of types is a sure cause for a decreased yield to the maltster. Different types germinate differently and can not be malted uniformly when mixed.

Pearled barley is made by the removal of the outer portions, leaving a round pellet which is free from hulls and bran. Barley for this purpose must be free from weather damage and unbroken, as it is impossible to pearl a broken kernel. The larger and more nearly spherical the kernel, the more economical is the process and the better the product. For these reasons large-grained 2-rowed varieties are grown for pearl barley. The best variety is the Chevalier. This variety can be grown well in Montana and the Great Basin under irrigation and sufficiently well in the delta lands of California. Where the Chevalier does not grow well, the Hanna may be substituted.

Most barley breakfast foods are made from malt. Their requirements, therefore, are those of malting barley. If naked barley were grown in large enough acreages in definite localities, it is possible that a better market for it might be secured for special purposes.

Barley flour is new to this country, but the experience of 1917 has shown that in cases of wheat shortage it is a valuable reserve flour grain. Barley is usually seeded later than wheat and interferes little with the wheat acreage. It is a protection to our wheat supply, in case it is needed as a substitute for wheat flour. It can be milled by wheat mills and produces more pounds of flour per acre than wheat.

Barley flour when used alone does not make good raised bread. It can be mixed up to 20 per cent with wheat flour, without detriment to the quality of the bread. For hot breads where baking powders are employed 80 per cent of barley flour may be used.

The future of barley flour in America depends, to a considerable degree upon other factors than its nutritive and baking value. Unquestionably, barley flour is nutritious, and it mixes very well with wheat flour in the making of bread. The addition of barley flour darkens the loaf, and this is the main obstacle to its regular use. The American housewife prefers a white bread, even at the expense of some food value. Although barley will not make as white a loaf as wheat, the desire for light color can be partially met by careful milling and the use of selected varieties.

Undoubtedly the first barley milled in this country was of too high extraction to be permanently satisfactory. The flour was nutritious and probably contained a large amount of desirable mineral elements, but the dark color caused dissatisfaction. As high as 70 per cent of flour was often secured, when the percentage, from the trade standpoint, should have been not more than 60 per cent, and probably should have been less. Machinery or methods that completely eliminate the glumes and other enveloping tissues before or after grinding will doubtless add much to the appearance of the flour. In using the so-called blue varieties it may be necessary to remove the aleurone layer as well.

Some varieties are better suited than others for milling. Less waste occurs with large-grained varieties than with small-grained ones. If grown for milling, the sorts with white aleurone layers are preferable to those with blue aleurone layers. The Chevalier is perhaps the best variety for milling that is grown extensively at present. The White Smyrna and Hannchen are suitable varieties, adapted to definite sections mentioned elsewhere. Until there is a definite market preference which carries with it a noticeably higher price per bushel, the farmer can not be expected to sacrifice high-yielding varieties for those less well adapted. Where large-grained varieties with white aleurone layers produce as much as those with smaller

grains or blue aleurone layers, the farmer may readily anticipate the demand by seeding them in preference.

STOCK FEED.

The value of barley as a feed is not appreciated by the eastern farmer. In the West where corn is not grown, barley is utilized and is fed understandingly. In the humid region its possibilities have been so obscured by the habit of corn feeding that barley is hardly considered in live-stock farming. On account of the high acre yield of corn, barley can not compete with corn where labor is sufficient to make corn the exclusive grain crop. Where small grain is raised as a part of the farming program, barley is often the most profitable. The sections where this is likely to be the case are indicated on the map (fig. 2). Where grain is to be purchased to supplement the farm production, barley by all means should be considered. Pound for pound, its relative value is shown in Table II. Its value as a feed is not entirely revealed in the table, since the suitability of different grains to different classes of live stock does not depend entirely on their chemical composition. Oats, for instance, are unsuited to the feeding of pigs because of the large amount of hull. Barley, on the contrary, can be used with success and is especially prized for the production of bacon. Barley, on account of its high protein content, is usually better for growing stock than corn, while corn is usually superior for a fattening ration. The following statement¹ indicates the value of barley as a feed:

On the Pacific slope, where corn or oats do not flourish in equal degree, barley is extensively used as a feed for animals. The horses of California are quite generally fed on rolled barley, with wheat, oat, or barley hay for roughage. Barley is the common feed for dairy cows in northern Europe. The Danes sow barley and oats together in the proportion of one part of barley to two of oats, the ground mixed grain from this crop being regarded as the best available feed for dairy cows and other stock. Fed with legume hay to fattening steers and lambs, barley has given nearly as good returns as corn. For horses, barley is somewhat less valuable than oats. At the Virginia station,² calves made excellent gains on barley and skim milk, but corn proved cheaper. In Great Britain and northern Europe barley takes the place of corn for pig feeding, leading all grains in producing pork of fine quality, both as to hardness and flavor. In American trials somewhat more barley than corn has been required for 100 pounds gain with fattening pigs. * * * Though barley is somewhat higher than corn in crude protein, it is still decidedly carbonaceous in character and should be fed with legume hay or with a nitrogenous concentrate for the best results.

The food value per acre for barley has been indicated in Tables I and III, in which the pounds per acre have been multiplied by the percentages of protein and carbohydrates to show the pounds of digestible nutrients. Corn, on account of the high yield, gives higher returns than barley in the sections where corn can be grown.

¹ Feeds and feeding. W. A. Henry and F. B. Morrison. 1915 edition, p. 162.

² Grains to supplement skim milk for calves. J. R. Fain and M. P. Jarnagin. Va. Agr. Exp. Sta. Bul. 172, pp. 81-94.

FEEDING BARLEY.

Success with barley depends in part on how it is fed. Barley fed whole is too hard for the best results, as much of it remains undigested. If barley is finely ground, it makes a pasty mass in the mouths of the animals, which is evidently disagreeable, since they consume much less grain and consequently put on less flesh. The grinding machinery should be so set that the grain is merely cracked and not ground to the fineness of meal or flour. Where it can be done, a desirable method of preparation is rolling. Rolled barley is used throughout the West and should become common in the upper Missouri and Mississippi River valleys. In the latter regions the feeding of barley is much less common than it should be. Throughout this area barley is easily grown and can readily furnish the grain feed in a better balanced system of farming. It is desirable that a greater number of live stock be kept on the farms. Grain farming at usual prices is yielding gradually decreasing returns on some of the best farming lands, and it has been extended into regions where it is not and probably can not be made continuously profitable. The hope of improvement in each case lies in live stock. For adequate live-stock husbandry a carbonaceous grain is necessary. Much of the area is beyond the limit of corn for grain, though it is profitable for silage. Barley has a real place in establishing this area on a firm economic footing.

Barley is a good grain feed; cracked barley is better, and it is believed that rolled barley is still more desirable. The rolled product is shown in figure 6. Any pair of heavy rolls will do the work. In the West there are large central mills which roll barley for a moderate charge. In these large mills the grain is steamed by a jet of live steam entering the stream of barley just before it reaches the rolls. The steam does not have time to penetrate the grain, which is in no way cooked or wet but merely moistened. The moisture thus added prevents any disintegration of the kernel and causes it to be merely flattened.

There are small outfits on the market for rolling barley on the farm. In these there is no provision for steaming, and the product is in consequence not quite so desirable. Such outfits, however, may prove especially useful in the humid sections of the United States, where steaming might lead to storage difficulties.

PASTURING BARLEY.

Winter barley is sometimes used for pasture in the South, but is of minor importance compared with winter oats or rye. When intended for this purpose, it should be seeded earlier than for a grain crop, so that the plants may become well established before the first

cold weather. A heavier seeding than for a grain crop is desirable. Drilling is preferred to broadcasting. Barley is also used occasionally as a cover crop in this region.

VARIETAL REGIONS.

The varieties of barley grown are grouped readily on the basis of the regions of production indicated on the map (fig. 1). While some of the varieties that do well in the humid-spring area can be grown successfully in the arid regions, those typical of the arid region, especially the sections of the Great Plains, do not do well under humid conditions. Barley from neither of these regions does well in the

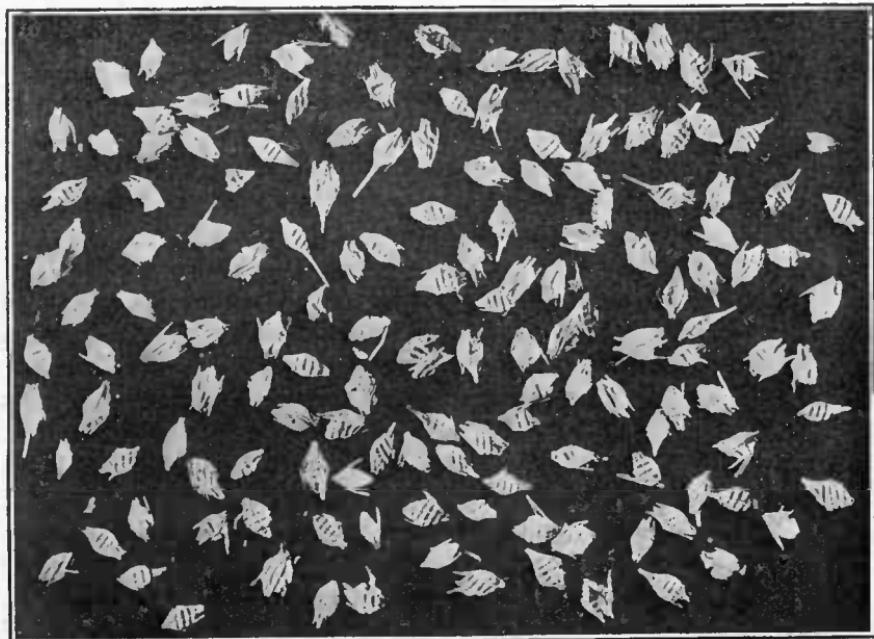


FIG. 6.—Rolled barley: A common way of preparing barley for feed in the West.

humid-winter region. Each of these three regions is characterized by a predominating commercial type that is more or less well adapted to the whole area and that is almost certain to yield well wherever planted. In present practice the outstanding variety of the arid region is the Coast barley (sometimes known as California Feed or Bay Brewing), but it is not the most promising sort in the northern Plains. The characteristic type of the spring-humid region is the Manchuria-Oderbrucker. The Manchuria and Oderbrucker varieties, while of different origin, are quite similar, and as neither is pure, they are usually indistinguishable in the field. The best-yielding type in the humid-winter area is the Tennessee Winter. None of these types is a pure variety, and in each case high yields are ob-

tained from their close geographical relatives when these are similar in type and source. These three types are shown in figure 7.

The Coast variety is a 6-rowed barley composed of many similar strains. Some of these are white, while others have an aleurone layer showing a blue tinge. All are large grained, of relatively low nitrogen content, and possess harsh awns which do not break off readily in threshing. Owing to the fragments of awns which cling to many kernels, the grain does not run through the drill readily; and the drill therefore should be set at a somewhat heavier seeding rate than if Manchuria, for example, were to be used. The Coast barley probably came from North Africa, most likely through Spain. Wherever the Coast variety does well, other North African barleys do well. South American sorts, which doubtless were introduced into South America by Spain, yield well in the arid region. One such has been grown to a small extent under the name Peruvian.

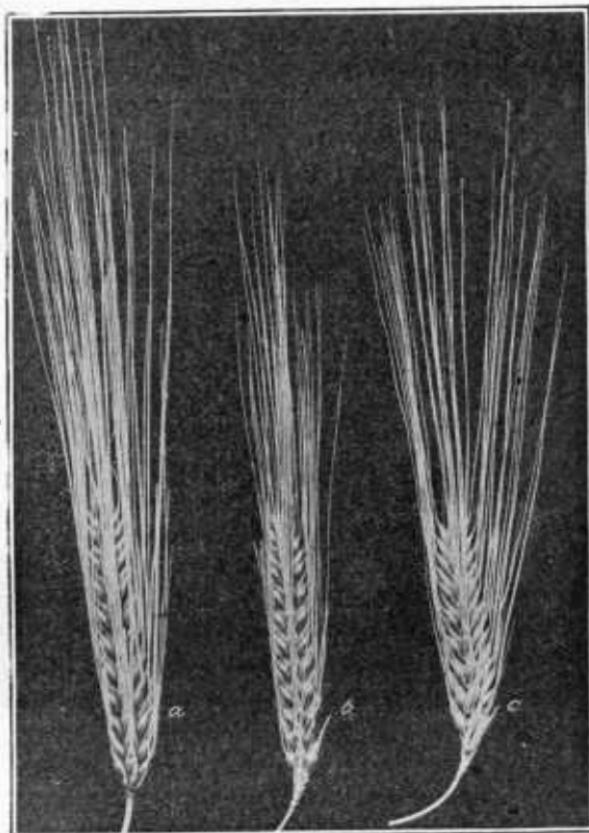


FIG. 7.—Spikes from the predominating variety of barley in each of the three climatic regions: *a*, Coast (arid); *b*, Manchuria (humid spring); *c*, Tennessee Winter (humid winter).

As previously remarked, the Manchuria and Oderbrucker barleys of the humid-spring region are very similar. Both are nodding 6-rowed forms having smaller kernels and more slender spikes and beards than the Coast barley. As in the Coast, they represent a type and not a pure variety. In each may be found white and blue-tinted strains. In field culture there is more blue in the Manchuria barley than in the Oderbrucker, and many of the selected strains of Oderbrucker are taller than the Manchuria. They have become so mixed that the original character of either is not easily determined. Selec-

tions of the Manchuria barley predominate in Minnesota and the Dakotas, while Oderbrucker selections are more commonly grown in Wisconsin. Although the Oderbrucker came from Germany, it probably has a common ancestry with the Manchuria. The only close relatives of the Oderbrucker and Manchuria barleys in farm culture are the Manshuria and Scotch. The term Manshuria is only a corruption of Manchuria, and the variety is not a separate sort. The Scotch was formerly quite common in the districts now growing Oderbrucker, to which it is very similar.

The Tennessee Winter barley is similar in appearance to the Manchuria. It has three or four more or less indistinguishable compa-

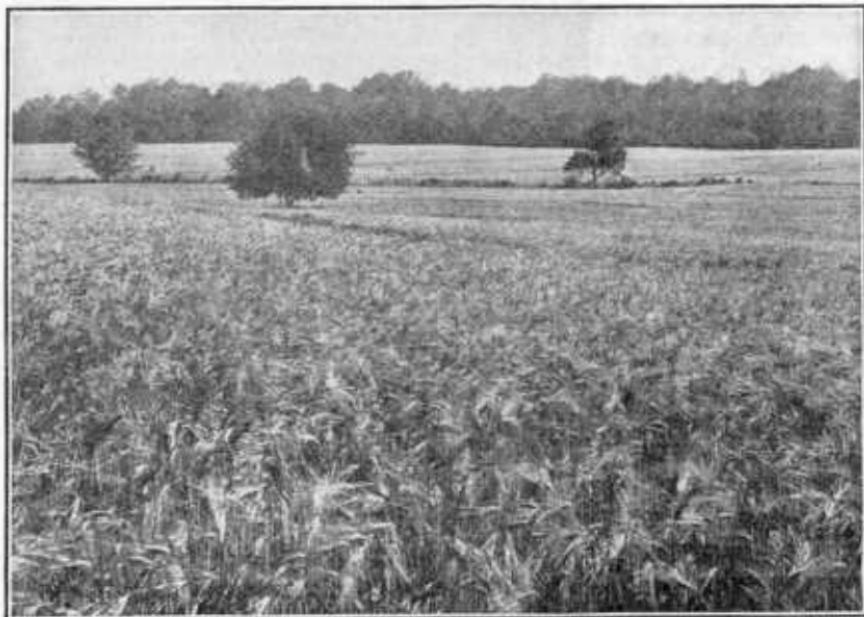


FIG. 8.—A field of Tennessee Winter barley.

ion varieties. The Maryland Wintor and Texas Winter are probably identical with it. Prof. Mooers, of Tennessee, states that the Union Winter differs constantly from the Tennessee Wintor in time of heading and ripening. A field of the Tennessee Winter variety is shown in figure 8.

VARIETAL AREAS.

In each of the three great regions may be found minor areas to which some particular variety or strain is especially adapted. The arid region presents more of these localities than either of the others, as would be expected from its diversity of climate. In the northern Plains, 2-rowed varieties succeed better than 6-rowed. In northeastern Colorado, western Nebraska, western South Dakota, and western North Dakota, Hannchen has proved very dependable. This

is a narrow, nodding, 2-rowed barley. Many of its awns fall off about ripening time. In Montana on dry land the White Smyrna variety is coming into favor. It is also grown some in Wyoming and in the Great Basin. It is an extremely short-strawed 2-rowed variety, with an excessively large grain. It is often cut with difficulty with a binder, but is harvested readily with a header. The first impression is almost always adverse to this variety, but its large yields and attractive grain are steadily extending its culture. In the irrigated sections of Montana and even South Dakota, the Chevalier is a favorite variety. A considerable quantity of this sort is grown in the Gallatin Valley of Montana. It is similar to the Hannchen, but it matures much later and has a larger kernel. It is a favorite with the millers of pearl barley. In Idaho, under irrigation almost any variety yields well. On account of the ease of culture, the

Coast type is the most common. The Chevalier, White Smyrna, Hannchen, and Trebi varieties are grown. The last is a very high-yielding sort just coming into cultivation.

At high altitudes and in places of very low rainfall coupled with high temperature, hooded varieties are grown to some extent. At high altitudes the Nepal, a 6-rowed, hooded, naked variety is frequently grown. It is quite early. In the southern Plains and parts of Oregon and Washington small areas of Horsford are grown. This is similar to the Nepal, but hulled instead of naked. In parts of South Dakota, where hot, dry weather comes on early and suddenly, early-maturing varieties are preferred. The Gatami has done well under



FIG. 9.—Spikelets of five varieties of barley suited to areas in the arid region: *a*, Hannchen (Northern Plains and Great Basin); *b*, Smyrna (Montana and bordering areas); *c*, Chevalier (irrigated and subirrigated lands); *d*, Mariout (late seeding in California and the Great Basin); *e*, Nepal (mountain districts and for hay).

such extreme conditions. It is a 6-rowed, awned, black-hulled variety.

In the Great Basin a winter variety known variously as Winter Club, White Club, and Utah Winter is occasionally grown. It is a dense, 6-rowed, awned, hulled variety.

In the humid-spring region there are no sharply defined local areas.

In Michigan a winter barley has been developed which is reported as promising by the Michigan Agricultural Experiment Station. The northeastern part of the region is well adapted to the production of the Hanna variety, but it has not yielded as well as the Manchuria in New York.

In the humid-winter area the localities are classified on the presence or absence of barley rather than on the kinds of barley. The production is almost all in the mountain districts, although a small acreage is grown in the Piedmont area. The total production is small.

TABLE VI.—*Description and adaptation of the varieties of barley most frequently found in field culture.*

Classification, variety, and synonyms. ¹	Description.					Region adapted.	Area of special adaptation.
	Kernel rows.	Color. ²	Hulls.	Awns.	Spike.		
Three principal type varieties:							
Coast.....	6	White..	Hulled..	Awned..	Lax...	Arid.....	
Manchuria and Oderbrucker (Manshury).	6	...do....	...do....	...do....	...do...	Humid spring.	
Tennessee Winter.	6	...do....	...do....	...do....	...do...	Humid winter	
Important minor varieties of less extensive distribution:							
Chevalier.....	2	...do....	...do....	...do....	...do...	Arid, irrigated	Northern irrigated lands.
Hannchen.....	2	...do....	...do....	...do....	...do...	Arid.....	Northern Plains and the West.
Mariout.....	6	...do....	...do....	...do....	Dense.	...do.....	Late seeding in California and in the Great Basin.
Smyrna, white.....	2	...do....	...do....	...do....	Lax...	...do.....	Montana.
Trebi.....	6	...do....	...do....	...do....	...do...	Arid, irrigated	Great Basin.
Winter Club (White Club, Utah Winter).	6	...do....	...do....	...do....	Dense.	Arid.....	Great Basin, fall seeding.
Less important minor varieties:							
Beldi.....	6	...do....	...do....	...do....	Lax...	...do.....	About as Coast.
Gatami.....	6	Black..	...do....	...do....	...do...	...do.....	Severe summer conditions, Northern Plains.
Hanna.....	2	White..	...do....	...do....	...do...	Arid, humid spring.	
Himalaya (Guy Mayle).	6	Blue...	Naked..	...do....	...do...	Arid.....	Northern Plains.
Horsford (Success, Beardless).	6	White..	Hulled..	Hooded..	...do....	...do.....	Southern Plains.
Nepal (White Hull-less, Beardless).	6	...do....	Naked..	...do....	...do...	Arid, humid spring.	Rocky Mountains.

¹ Synonyms are indicated by italic type in parentheses.

² In the hulled varieties the color refers to the glume only. Some of the white-hulled sorts have blue aleurone layers.

WHAT VARIETY TO GROW.

In general, it is best to grow one of the three standard commercial types, depending upon the region in which the grower lives. These types are the Coast, the Manchuria-Oderbrucker, and the Tennessee Winter. If the farm is located in a definite subdivision of one of these regions, varieties of such local adaptation should be used where seed is available. The five most conspicuous cases of special adaptation are Hannchen for the northern Great Plains, White Smyrna for the Montana dry lands, Chevalier for the Montana irrigated lands, Trebi for irrigated lands of the Great Basin, and Mariout for late seeding in California. Spikes of four of these are shown in figure 9. The State experiment stations should be consulted, as they are in a position to know the local variations which may determine the use of varieties. The character of the more important varieties may be seen in Table VI.

WHERE TO PROCURE SEED.

Seed should be obtained locally where possible. Seed of the three main types can be secured readily in any quantity through a large number of agencies. The Coast barley is handled by all grain dealers, elevators, and seedsmen of the West. The Manchuria and Oderbrucker are similarly handled in the northern Mississippi Valley. Many of the States have grain growers' associations which produce a better grade of seed, often of selected strains. These associations usually have a representative on the State experiment station staff from whom all information can be obtained. The Tennessee Winter barley is handled by southern seedsmen and by some grain dealers in the region of heaviest production.

The varieties of local adaptation are more difficult to secure. In most cases their culture is so recent that large lots of seed are not available. The Chevalier can be obtained in quantity in the Gallatin Valley of Montana, and considerable Hannchen has been distributed by the substations of South Dakota. There is a small production of Smyrna in Montana which so far has all been absorbed by local buyers of seed. The Trebi is not yet produced in quantity.

DISEASES.

Barley is not commonly subject to heavy infections of diseases. Its freedom from rust accounts in part for the practice of seeding it on lands where the planting of spring wheat is delayed to the point of danger. Barley is not immune to rust, and very late seedlings are sometimes damaged. There is generally a small percentage of loose smut in barley and a varying percentage of stripe diseases. The stripe diseases, according to recent studies, appear to be of greater importance than was formerly thought to be the case. They may

eventually demand specific effort toward their prevention. At the present time only one barley disease is of clear-cut economic importance, for which recommendations of seed treatment are widely urged. This is the covered smut, which can be distinguished from the

loose smut through the fact that the smut balls which displace the seed persist in the covered smut, but are broken up and dispersed by the wind before harvest in the loose smut. Formaldehyde is not effective in treating loose smut. These smuts are shown in figure 10. The importance of covered smut seems to vary inversely with the rainfall of the harvesting months. In the humid regions it is of only sporadic importance, the greater part of the fields escaping with unimportant losses. In the arid regions there is a gradual increase in infection, culminating in frequent, heavy losses in the Palouse district and parts of California.

Wherever the in-



FIG. 10.—The covered and loose smuts of barley: *A*, Covered smut, in which the kernel is replaced by masses of spores, which are broken apart and mixed with the grain in threshing; *B*, loose smut, a form wherein the entire spikelet is replaced by a mass of spores, which upon maturity are scattered by the wind, leaving only the bare stems as evidence of the disease.

fection assumes any considerable importance, provision should be made for better conditions the following year. If clean seed can be secured, it should be used. Clean seed is to be preferred to treated seed. If it can not be secured, the seed should be treated with formaldehyde, 1 pound to 40 gallons of water.

The sprinkling method is not effective with the covered smut of barley. The method known as "soaking and skimming" is to be preferred. Place the solution in tubs or other containers and pour the grain in. Stir thoroughly. The stirring brings the smut balls to the surface, where they can be skimmed off. After skimming, remove the grain; pile and cover 2 to 5 hours with bags or canvas previously treated with formaldehyde. Make germination tests of treated seed to determine the amount of injury. Increase the amount of seed per acre to cover injury and swelling. Although the danger of seed injury in barley is much less than in wheat, some farmers prefer to treat only a seed plat for the next year's stock. When this method is used, the seed plat should be treated annually.

When the clean or treated seed is finally available for seeding, care should be taken to avoid reinfection. The drill should be disinfected with the formaldehyde solution and used sacks avoided. If the crop of the following year is clean and suitable for seed, care should be taken that the thrashing machine has not come directly from a field of smutty barley. If smutty barley was the last crop thrashed, the machine should be disinfected as far as possible. The same precaution should be taken with respect to the bins and sacks. Keep the disease out by sanitary measures when possible; when not possible, treat the seed.

SUMMARY.

The United States may be divided into three barley regions, which differ in economic, cultural, and varietal aspects—the arid, or western; the humid-spring, or northeastern; and the humid-winter, or southeastern.

In the arid region, the Great Plains, the Great Basin, and the Pacific coast are well-defined subdivisions.

Barley is most profitable as a primary crop, but is a valuable secondary crop, as when it is used for late seeding in the spring-wheat region or to clean weedy fields.

The best barley lands are well-drained soils that are not sandy. Heavy loams are the best. It should not be seeded on poorly drained or light sandy lands.

Barley is a cool-weather plant. The best conditions of growth are found in early spring. In the humid regions, south of those sections where the summers are cool, early seeding is of vital importance.

Barnyard manures in the humid-spring region should be applied to the previous crop, as they induce lodging when applied to barley. The use of commercial fertilizers on barley is at present limited largely to the Eastern and Southern States.

Good seed of a good variety, well matured, well cleaned, and free from weed seeds and diseases, is an insurance that the crop starts without a handicap. A good seed bed will promote the initial growth.

Fall plowing in the humid-spring region, disked corn ground in the Great Plains, and summer fallow in regions west of the Rocky Mountains are the best methods of preparation.

Early seeding is necessary to secure maximum returns. In the northern Plains, the loss from seeding delayed beyond April 25 is more than 1 per cent a day.

In the humid sections, 2 bushels are usually seeded. The rate decreases with the decrease in rainfall. In the driest sections, 3 or 4 pecks is sufficient.

The depth of seeding varies from $1\frac{1}{2}$ inches in the humid regions to $2\frac{1}{2}$ or 3 inches in the Great Basin.

The best method of seeding is with the grain drill.

Barley should be mature when harvested, but should not be allowed to stand until the losses from shattering become important. The varieties of the humid region and Great Plains shatter more than those of the arid regions.

The best method of harvesting is with the grain binder. The combined harvester is cheaper to operate, but the losses are greater.

Grain must be shocked and stacked, so as to suffer the least weather damage possible. Care should be taken in thrashing that few kernels are broken. Close thrashing decreases the market price of malting barley.

Barley is manufactured into malt, pearled barley, breakfast food, and flour. The malting trade demands a grain that is clean, plump, free from weather, bin, or thrashing damage, and of high viability.

Barley is an important reserve flour grain. From 15 to 80 per cent of barley flour can be mixed with wheat flour, depending upon the type of bread to be baked.

On account of its high acre yield barley should be more widely grown for stock feed. Through the Northern and Western States, it should replace oats to a considerable extent. It may be fed whole, but is better rolled or coarse ground.

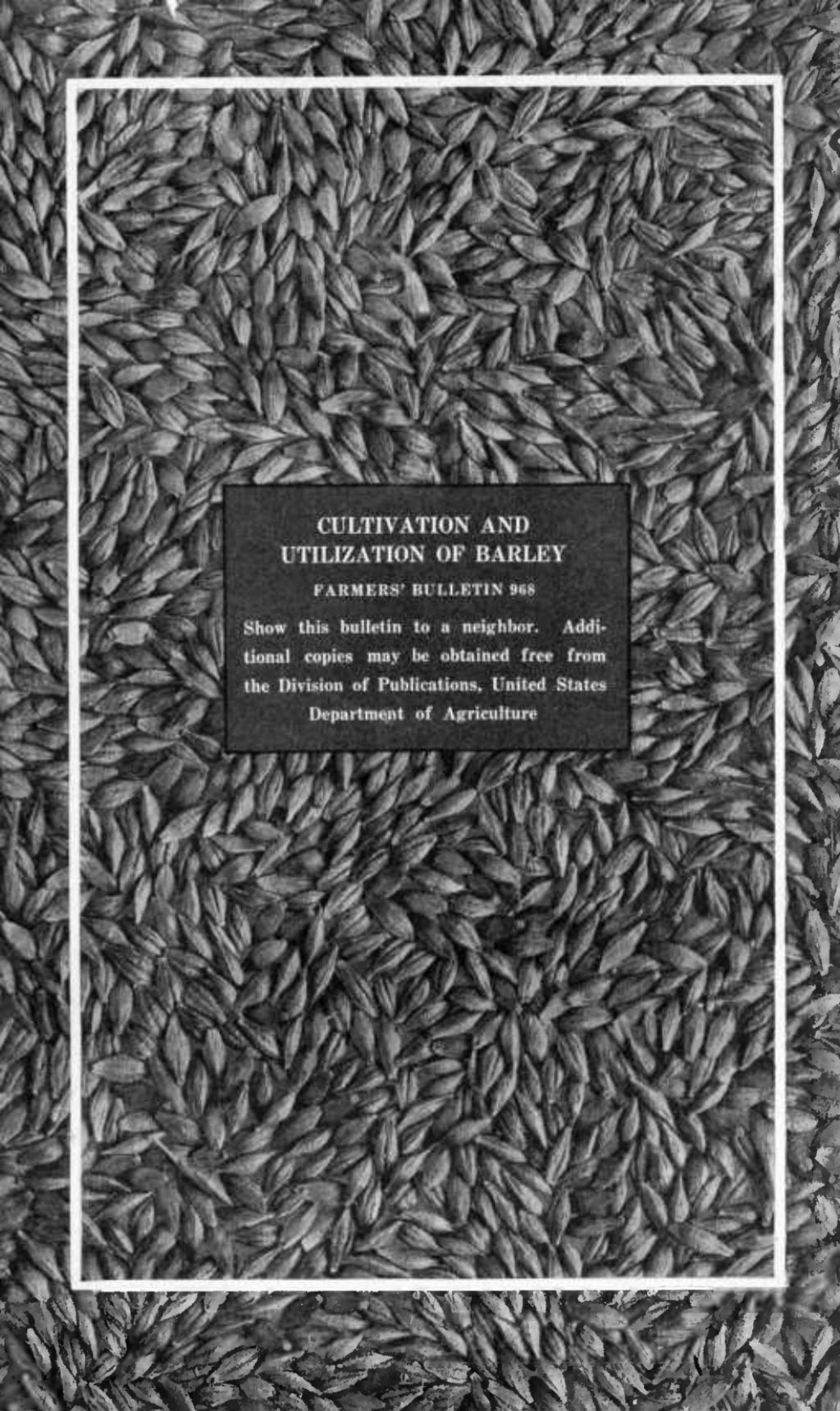
In present practice each of the three regions has a predominant type that succeeds well throughout that region. These are the Coast in the arid region, the Manchuria and Oderbrucker in the humid-spring region, and the Tennessee Winter in the humid-winter region. Of the less widely grown varieties, the Hannchen does well almost anywhere, but seems particularly adapted to the middle Plains. In Montana, the White Smyrna is superior, and in the southern Plains, the Horsford. In the Great Basin, in addition to the Coast, the Mariout and Hannchen are promising. In California, besides the

Coast, the Mariout is useful for late seeding. Under irrigation the Trebi, in the Great Basin, and the Chevalier, in Montana, are especially well adapted.

The covered smut is an important source of losses in the dry regions, especially in eastern Washington and Oregon.

Disease-free seed should be obtained, if possible. If this is not possible the seed should be treated.





**CULTIVATION AND
UTILIZATION OF BARLEY**

FARMERS' BULLETIN 968

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